

WHAT IS CLAIMED IS:

- 1 1. A method for color-calibrating a printing device;  
2 said method comprising the steps of:  
3 using the printing device to print a gray ramp with  
4 black ink;  
5 using the same said printing device to print a nomi-  
6 nally gray ramp with composite-black ink;  
7 measuring and comparing the printed gray ramps; and  
8 employing the measured black-ink ramp as a standard  
9 to correct the measured composite-black ramp.
- 1 2. The method of claim 1, wherein:  
2 all the steps are performed automatically.
- 1 3. The method of claim 1, wherein:  
2 the employing step comprises treating the black-ink  
3 ramp as a zero-chroma standard to correct chroma found in  
4 the composite-black ramp.
- 1 4. The method of claim 1, further comprising the step  
2 of:  
3 using the compared black-ink and composite-black  
4 ramps to also correct other printing with composite black.





1 14. The method of claim 13, wherein:

2 the colorimetric equations include plural expressions  
3 having the form:

4  
5 
$$H(t,n,a) = D(t,n) \cdot E(t,n) \cdot . . . \cdot F(t,n),$$

6  
7 wherein H is a hybrid color printed by use of at least two  
8 constituent colors,

9 D is one of the constituent colors,

10 E is another of the constituent colors,

11 ". . ." represents possible additional constituent  
12 colors of said at least two,

13 F is a correction factor,

14 t is a tonal level at which H, D, E and ". . ." are evaluated,

15  
16 n is a sensor channel at which all the above are  
17 evaluated, and

18 a is a scaling factor that relates overall range  
19 of the hybrid color with overall range of the  
20 constituent colors.

1 15. The method of claim 14, wherein:

2 in some of the expressions,  $H = cK$ ,  $D = S_1$  and  $E =$   
3  $S_2$ , where cK is composite black and  $S_1$  and  $S_2$  are secondar-  
4 ies; and

5 in others of the expressions,  $H = S$ ,  $D = P_1$  and  $E =$   
6  $P_2$ , where S is a secondary and  $P_1$  and  $P_2$  are primaries.

1 16. The method of claim 15, wherein:

2 in said others of the expressions  $\underline{a} = 1$ .



1 22. The printer of claim 18, wherein said measuring means  
2 comprise:

3 means for illuminating the printed ramp in at least  
4 two spectral bands; and

5 at least one sensor for detecting illumination re-  
6 flected from the printed ramp in the at least two spectral  
7 bands separately.

1 23. The printer of claim 22, wherein:

2 the illuminating means comprise a lamp emitting in  
3 the at least two spectral bands; and

4 the sensor comprises spatially, temporally or absorp-  
5 tively selective means for separating illumination from  
6 the at least two spectral bands.

1 24. The printer of claim 18, wherein:

2 the programmed processor comprises compensation means  
3 for adjusting subsequent operation to substantially mini-  
4 mize chroma in printing of nominal gray.

1 25. The printer of claim 24, wherein:

2 the compensation means comprise means for reducing  
3 chroma, in printing of nominal gray, to  $\Delta E$  of approximate-  
4 ly 2.5 or less; and

5 the notation  $\Delta E$  represents the color distance in the  
6 CIEL\*a\*b\* space.

1 26. A method for automatically color-calibrating a prin-  
2 ter; said method comprising the steps of:  
3 using the printer to print a ramp in a particular  
4 color with actual ink of that color;  
5 using the same said printer to print a ramp nominally  
6 in said particular color but with inks of other colors;  
7 measuring and comparing the printed ramps; and  
8 using the measured actual-ink ramp as a standard to  
9 calibrate and correct the measured other-colors-ink ramp  
10 and also to correct other printing with said other colors.

1 27. The printer of claim 26, wherein:  
2 said actual ink is selected from the group consisting  
3 of:  
4 red ink,  
5 green ink, and  
6 blue ink;  
7  
8 and said inks of other colors are selected from the  
9 group consisting of, respectively:  
10  
11 magenta ink and yellow ink,  
12 yellow ink and cyan ink, and  
13 cyan ink and magenta ink.

